TO JOHN COLLINS JAN 84 FEB 84 GEORGE SHAW - DESERT SPRINGS

Report and Data Analysis

SPANISH SPRINGS VALLEY ANALYSIS OF AQUIFER AND WATER WELL RESPONSE

For

DESERT SPRINGS UTILITY COMPANY (DAVCO)

By

Keith N. Meador, P.E.

In Association With

WATERESOURCE CONSULTING ENGINEERS, INC.

May, 1980

wateresource
consulting engineers
RENO, NEVADA

Pulling Pump mon 16th
Will need Two section of pipe
Also. will check old pump after
Pulling before setting new one,
only Takes Two day To get a new one
JR

Mr. Jess Coffman
Washoe County Water Resources
4930 Energy Way
Reno, NV. 89502

Dear Jess,

Enclosed is a copy of invoice #316 for the work that was completed to the Desert Springs Well #3, located in Spanish Springs. We mobilized to the site on July 10th, and removed 105' of 6" drop pipe. After we removed the pump and 75hp submersible motor, we seperated the pump from the motor and found that the height of the motor shaft was 5/8" lower than it was supposed to be. I called Franklin motors and they claimed that the bearing in the bottom of the motor had failed completely and it was beyond repair. I called Johnny, explained what happened to the motor and that we would have to replace the motor. The only motor I could locate was in Fresno, so I left that evening and picked the motor up on Saturday morning.

When I arrived back in Reno, we immediately began to reinstall the pump and motor. Before we connected the pump to the motor, I removed the bottom inlet and checked the bowl for wear. There was some damage to the skirts on the impellars because they started to drag when the bearing went out of the motor. The damage shouldn't effect the performance of the pump and I didn't think it was that severe. We reassambled the pump and motor and reinstalled the pipe. During the installation of the last two pieces of drop pipe, I did notice that they didn't screw together straight. The thread must be cut at an angle on the pipe. I suggest that this fall, when you can get by without the well for 1/2 a day, to remove the 2 peices of pipe and replace them with new ones. After the pump was installed , we started it and pumped it to waste for 1 hour and then turned it back into the system. While the pump was operating, I checked the amperage draw at L1-83, L2-89 and L3-83 amps. Full load amps on the 75hp motor are 97 and SF at 107amps. The well was producing 618 gpm with 78 psi. The new motor is a Franklin, 8", s/n030019-98C17.

If you have any questions on this information or the invoice, please call me and I will be happy to discuss it with you.

Sincerely

Dan Trampe

Post-it® Fax Note 7671	Date	# of pages ▶
To Scott Smith	From Dan	
Co./Dept.	Co. Carson Pump	
Phone #	Phone #	
Fax #	Fax #	

Bruce MacKay Pump & Well Service, Inc.
1600 Mount Rose Highway
RENO, NEVADA 89511
(702) 851-1600

INVOICE

№ 7540

DATE OF ORDER	DATE COMPLETED
7/21/97	/ /

CUSTOMER'S ORDER NO.	HOME PHONE	MECHANIC	HELPER	PHONE
P.O.# 166950	328-2280			

BILL TO: Washoe Co Purchasing - Comptroller	Jess 856-7300
ADDRESS: P.O Box 11130 UT/L	Carl Sterner
CITY: Reno NV 89520	
JOB NAME AND LOCATION:	

WELL DEPTH	PUMP SETTING	PIPE SIZE	TANK SIZE	PUMP MAKE	PUMP D CODE
278	105	6" Black	—	HAYS	
STATIC WATER	**PUMPING LEVEL**	**GPM**	**WIRE #-TYPE**	**PUMP MODEL**	**MOTOR D CODE**
37	68	790	2/3 WG	750-8BCH	

DESCRIPTION OF WORK: Pull 75 hp pump on 6" drop pipe - Install new pump, motor, 63' X 6" pipe, check valve, splice kit, wire.
Pull pump and install new design pump. Original design 60 psi @ 40' pwl. New Design 80 psi @ 70' pwl. No charge for labor on pull & set of new pump.

Pump - $3,137.00, 75 hp motor - $8,789.00, pipe - 1,360.00, check valve - 481.00, splice kit - 42.80, wire - 715.00, misc rubber guards & clamps - 50.00, restock original ordered pump - 261.10
Pull & set (one time)

PLEASE PAY FROM THIS INVOICE
TERMS: DUE UPON RECEIPT

Upon buyer's failure to pay in full within 10 days, buyer agrees to pay a FINANCE CHARGE OF 2% PER MONTH, 24% PER ANNUM, PLUS any other collection costs incurred.

Equipment to remain the property of Bruce MacKay Pump & Well Service, Inc. until such time as said equipment and labor is paid for. There is a $25.00 charge for returned checks. # 88-73-0007K TAX Exempt

TOTAL LABOR	1,260	00
TOTAL MATERIALS	14,835	90
Freight	162	20
TAX	Exempt	
TOTAL AMOUNT	$16,258	10

Signature: 8-26 Lift [illegible] w/ Casey [illegible] D.17

I hereby acknowledge the satisfactory completion of the above described work.

8/27/97 OK per Jess to pay $16,258.10 instead of [illegible] apparently MacKay overhead [illegible] lot higher because their charge [illegible] more than Carson Pump [illegible]

IN TRIPLICATE
(PLEASE PRINT)

BUREAU OF LABORATORIES AND RESEARCH
NEVADA STATE DEPARTMENT OF HEALTH

7530

52022

24 hr TEST 072

WATER CHEMISTRY:

To: Reno, Nevada 89503

WELL WATER: Pump should be delivering clear water before sampling

County: WASHOE
Township: 21N
Range: 20E Section: 34
Area: Spanish Springs

Date sampled: 11/30/79 Date submitted: 11/30/79

Owner: Jim PATTERSON
DESERT SPRINGS SUBDIV

WATER SOURCE:
Well ✓ Spring Surface
Hot Cold ✓ Depth: 306 Ft.
Casing diameter: 10 in depth: 306 Ft.
Now in use Yes ☐ No ☒

Report to:
Name: WCDHD
Address: P.O. Box 11130
City: RENO State: NV

ROUTINE DOMESTIC ANALYSIS
417 PLEASE CHECK BOX → 0.1256 ✓

FOR PARTIAL ANALYSIS
CIRCLE CONSTITUENT DESIRED

FOR CONSTITUENTS NOT LISTED BELOW PRINT IN
22 CONSTITUENT DESIRED IN SPACE BELOW

Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.M.
T.D.S.	410	Chloride	42	Iron	0.05				
Hardness	101	Nitrate	16.8	Manganese	0.00				
Calcium	29	Alkalinity	130	Color	15				
Magnesium	7	Bicarbonate	159	Turbidity	1.8				
Sodium	83	Carbonate	0	p.H.	7.81				
Potassium	5	Fluoride	0.62						
Sulfate	76	Arsenic	0.010						

RECEIVED
DEC 1979

Remarks:
Chemical quality meets the State of Nevada Drinking Water Standards

waterresource
consulting engineers, inc.

28 VINE STREET • RENO, NEVADA 89503 • 322-9443

GEORGE W. BALL, JR., P.E.

JAMES E. ARDEN, P.E.

June 25, 1980
File 7924

Mr. James Patterson
DAVCO
P.O. Box 1232
Sparks, NV 89431

Subject: Spanish Springs Valley--Analysis of Aquifer and Water Well Response Report

Dear Jim:

Enclosed are 25 copies of the subject report for your review and use. Mr. Keith N. Meador, P.E., in association with WCE, field coordinated the test hole drilling and subsequent electric logging of test holes, performed the pump test data analysis, and substantially developed this report. Much of the supporting data and calculations have not been included herein for the sake of clarity and brevity. A significant amount of this information is available for review in the offices of WCE and Meador.

In our opinion, the report presents sufficient data, calculations, and discussion to demonstrate that there is sufficient natural and secondary recharge available to the project area to allow the development of 2,000 acre-feet per year permitted water right without adversely affecting the existing water rights in this general area. Further, it can be observed that no adverse impacts on the ground water basin will be created as a result of the development of the existing approximately 300 approved units and the proposed approximately 450 units under land use District Case No. C-93-79W.

We will be available to review questions of the Planning Commission, County Commissioners, and DAVCO as required. Should you desire any further information concerning this subject, please advise.

Sincerely,

WATERESOURCE CONSULTING ENGINEERS, INC.

George W. Ball, Jr., P.E.
President

GWB/dmo
Enclosures
c: Keith N. Meador, P.E.
Walt Neitz, R.L.S.

REGIONAL PLANNING COMMISSION
OF RENO, SPARKS & WASHOE COUNTY

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DIRECTOR OF PLANNIN
Richard J. Allen

July 15, 1980

TO: John Collins, County Sanitation Engineer

Please find enclosed a copy of Spanish Springs Valley Analysis of Aquifer and Water Well Response prepared for the Desert Springs Utility Company. This report was prepared in order that Change of Land Use District Case No. C-93-79W could be placed on the Regional Planning Commission's agenda for reconsideration. Our office to schedule a meeting in the next month or so with the applicant and other interested agencies in order to review the enclosed document and receive comments pertaining to it. We will contact you as to the scheduled meeting. If a specific time or times would be more convenient for you, please contact our offices.

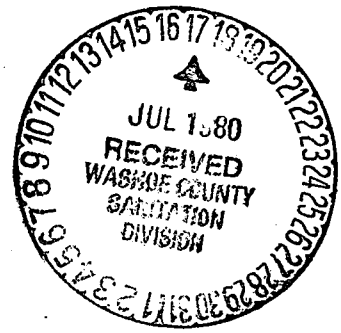
ROBERT N. YOUNG
Director, DRP

Michael A. Harper

Donald M. Bayer
By
Michael A. Harper
Planner II

RNY/DNB/MAH/mlf

Enclosure



REPORT AND DATA ANALYSIS

SPANISH SPRINGS VALLEY ANALYSIS
OF
AQUIFER AND WATER WELL RESPONSE

for

DESERT SPRINGS UTILITY COMPANY (DAVCO)

Prepared by

Keith N. Meador, P.E.

In Association with

WATERESOURCE CONSULTING ENGINEERS, INC.

May, 1980

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TABLE OF ILLUSTRATIONS

1. INTRODUCTION

Water permits have been issued to lands associated with the Desert Springs Utility Company (DAVCO) (see Plate I in envelope at back of report) totaling 2,000 acre-feet by the Nevada Division of Water Resources. This amount of water, in turn, is adequate to satisfy the domestic needs of 2,530 single-family dwelling units, each using an average of 500 gallons per day during a non-irrigation season of 215 days, and an average of 1,000 gallons per day during a 150-day irrigation season. These usages equate to an average annual residential usage of 705 gallons per day (gpd). Regulatory agencies have postponed granting approvals for future subdivision units pending demonstration by DAVCO that recharge to the underground reservoir is adequate to sustain the continuous water needs of the proposed development without adversely impacting the western portion of the Spanish Springs ground water basin.

Test hole drilling has been conducted upon the subject lands during years past. Water wells were constructed at two or three of the exploration sites. During 1979, a new test drilling project was undertaken. Target for this test drilling and resistivity logging was to identify and evaluate both the artesian and water table aquifers, as well as the clay-silt reservoir. Five test holes were drilled in approved areas and resistivity logs were made in two of the five holes to correlate with earlier exploration by Sierra Pacific Power Company and others. The driller, Paul Williams, made lithologic logs of all five holes which are also useful in correlating the underground conditions.

2. LOCATION

The subject test well is located within the SE¼ of the SE¼ of Section 34, Township 21 North, Range 20 East, MDB&M, Washoe County, Nevada (see Plate I, envelope at back of report). This location is accessable by auto or truck over 7.5 miles of paved State Route 33, north of downtown Sparks, and 0.2 miles of unimproved road west along the township line.

Surface elevation at the well site is 4,496 feet above sea level. All the water level measurements were made from the top of the ten-inch casing which has a measured elevation of 4,496.85 feet. All ground water measurements included in this report are reduced to this datum elevation of 4,496.85.

Average annual precipitation throughout the ranges in elevation for this valley is in the area of eight (8) inches. A more conservative fiture of seven (7) inches is employed for recharge considerations in this report. Refer to Water Resources Reconnaissance Series Report 57 entitled, "A Brief Water-Resources Appraisal of the Truckee River Basin, Western Nevada."

3. GENERAL GEOLOGY

The geology of the watershed contributory to Spanish Springs Valley is adequately studied and mapped by Harold F. Bonham, geologist for the Nevada Bureau of Mines. His maps and dissertation are presented in the Nevada Bureau of Mines Bulletin 70, dated 1969. While the valley is surrounded by hills and mountains dominated by igneous rocks, both intrusive and extrusive, the valley proper is occupied by geologically recent alluvium. This alluvium, as it is exposed at the surface and penetrated by drill holes below the surface, is dominated by sand and gravel formations interbedded with clay and clay-silts

strata. Drillers logs and electric resistivity logs in the immediate area of this study illustrate the lenticular nature of all these recent sedimentary formations. It is particularly noticeable that the clay and clay-silt formations thicken toward the center of the valley, while the sand and gravel members dominate in the edges and near the foothills. The driller's log of this test well (see Plate II, page 4) illustrates this condition when compared to other lithologic and electric logs in both the east and west directions. This test well location is described in the driller's log to be 45 percent clay or sandy clay, while the electric resistivity log of a test hole located 360 feet southeast of this location is 60 percent clay and clay-silt. A test hole drilled approximately 1,260 feet west of this subject well shows only 30 percent clay and silt. All this seems to illustrate that at various periods during the recent geologic past, this area, like the Truckee Meadows, was largely occupied by lake waters. Clay and silt particles will not settle out of moving water.

It is reasonable to assume that any new or additional test hole drilling northerly or southerly from this test well and parallel in direction to the valley axis would result in a similar lithologic log and expose clay-silt beddings in the ratio of 45 percent to 55 percent sand.

Fault structures are known to dissect the valley fill. Their locations are more inferred than they are defined on the ground. Fault structures act as hydraulic barriers but they are unable to restrict the migration of underground water for any long duration of time. By pumping and observing water wells in nearby valleys, it has been demonstrated that whenever dramatic hydraulic gradients are developed between opposite sides of a fault, the water

PLATE II

DIVISION OF WATER RESOURCES

WELL DRILLERS REPORT

Please complete this form in its entirety

Desert Springs North Well DS #3

1. OWNER SPANISH SPRINGS DEV. CO. or DESERT SPRINGS--Jim Patterson, Owner ADDRESS 7755 Pyramid Lake Highway Sparks, NV 89431

2. LOCATION SE ¼ SE ¼ Sec. 34 T. 21 N/S R. 20 E MDB&M Washoe County
PERMIT NO. 29286

3. TYPE OF WORK
New Well ☐ Recondition ☐
Deepen ☐ Other ☒ replacement

4. PROPOSED USE
Domestic ☐ Irrigation ☐ Test ☐
Municipal ☒ Industrial ☐ Stock ☐

5. TYPE WELL
Cable ☐ Rotary ☒
Other ☐ reverse

6. LITHOLOGIC LOG

Material	Water Strata	From	To	Thickness
sandy clay		0	23	23
sand		23	31	8
clay		31	43	12
sandy clay		43	55	12
clay		55	58	3
sand		58	73	15
fine gravel		73	77	4
sandy/clay streaks		77	186	109
sandy clay		186	190	4
sand		190	198	8
sandy clay		198	199	1
clay		199	203	4
decomposed granite		203	206	3
sandy clay		206	208	2
coarse sand		208	212	4
sand/clay streaks		212	216	4
coarse sand		216	227	11
clay		227	246	19
decomposed granite		246	253	7
clay		253	259	6
sandy clay		259	266	7
clay		266	268	2
sandy clay		268	271	3
clay		271	306	35

Date started 11/18/79, 19
Date completed 11/25/79, 19

7. WELL TEST DATA

Pump RPM	G.P.M.	Draw Down	After Hours Pump

BAILER TEST
G.P.M. Draw down feet hours
G.P.M. Draw down feet hours
G.P.M. Draw down feet hours

8. WELL CONSTRUCTION
Diameter hole 18 inches Total depth 300 feet
Casing record
Weight per foot 27 lb. Thickness 0.250

Diameter	From	To
10-3/4 OD inches	0 feet	300 feet
inches	feet	feet
inches	feet	feet
inches	feet	feet
inches	feet	feet
inches	feet	feet

Surface seal: Yes ☐ No ☐ Type
Depth of seal feet
Gravel packed: Yes ☐ No ☐
Gravel packed from feet to feet

Perforations:
Type perforation mill slots 3/32" x 2½"long
Size perforation
From 58 feet to 288 feet
From feet to feet
From feet to feet
From feet to feet
From feet to feet

9. WATER LEVEL
Static water level 22 Feet below land surface
Flow G.P.M.
Water temperature cold° F. Quality clear

10. DRILLERS CERTIFICATION
This well was drilled under my supervision and the report is true to the best of my knowledge.

Name /s/ Paul Williams
Address 22 South Patterson, Sparks, NV
Nevada contractor's license number 14483
Nevada driller's license number 957
Signed
Date 11/26/79

5471

will develop avenues of migration and equalize the "head" on both sides within a short period of time measured in days.

4. TEST WELL CONSTRUCTION

During November, 1979, Paul Williams constructed a ten-inch gravel-packed well in an 18-inch diameter drill hole to a total depth of 300 feet. The ten-inch well casing is perforated with milled slots which are 3/32-inch wide and 2.5 inches long and there are 20 slots per lineal foot between the levels of 58 and 288 feet. The driller's lithologic log (see Plate II, Page 4) and well construction diagram (see Plate III, page 6) illustrate the sand aquifer to have an effective thickness of 172 feet between the 58 foot and 253 foot levels. This 172 vertical feet of sand aquifer has an exposed area at the face of the 18-inch diameter drill hole of 810 square feet as follows:

Area = Circumference x thickness = πdt = (3.1416)(1.5')(172') = 810 sq.ft.

It can be shown that this area of sand aquifer, when exposed to a select gravel packing material, is capable of transmitting several thousand gallons of water each minute without exceeding the upper "non-sanding" velocity of six feet per minute. All of the water which departs the sand aquifer and enters the select gravel packing is able to move toward the milled perforations through the sand-free gravel at velocities much greater than six feet per minute and carry no sand. It is for this reason that a gravel-packed well can be developed to a sand-free condition in a relatively short period of time.

5. TEST PUMPING

The test well was constructed for the purposes of replacing water well No. 18

CONSTRUCTION DIAGRAM
WWDD342120

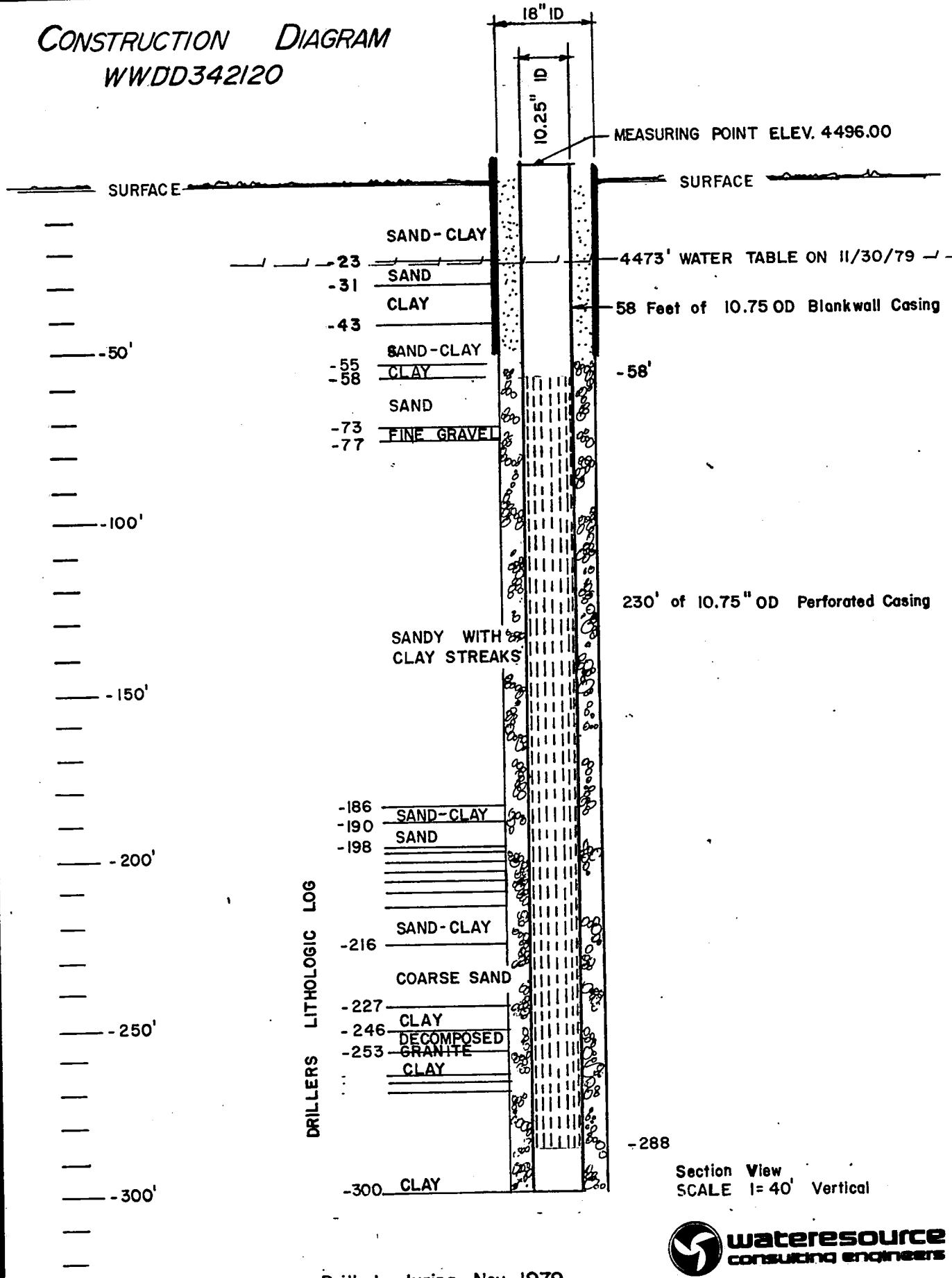


PLATE III

which is in an approved and permitted area. In this way, water well No. 18 became the observation well during the test pumping period.

On November 30 and December 1, 1979, the new ten-inch well was test pumped. Pumping began at 9:30 A.M. and was continuous to 12:30 A.M. on December 1. Due to natural drainage impediments created by construction on the southside of State Route 33, pumping was terminated prior to the desired 48-hour period. Water levels were measured in both the pumping well and the observation well at regular intervals during the 900 minute pump test and 430 minute recovery period (see Plate IV, page 8).

Some development pumping had preceded the test pump period. During the test pump period, the water was crystal clear and 59°F.

Pumping at the rate Q = 1,200 gallons per minute, the dynamic pumping level was stable from the first thirty minutes following "pump on" (see Plate V, page 9 and Plate VI, page 10). This pumping level was 30.85 feet below the water table prior to pumping. It is elementary then that the specific capacity of this fine water well is as follows:

$$SC = \frac{Qgpm}{drawdown} = \frac{1,200}{30.85} = 38.9 \text{ gallons per minute per foot of drawdown}$$

Plate VII (page 11) dramatizes the recovery detail following the test pump period. Due to circumstances beyond the engineer's control, these recovery measurements are inadequate in numbers and duration to accurately illustrate the radius of influence developed during the pumping period.

PLATE IV - DRAWDOWN DATA

WATCH TIME	ELAPSED TIME MINUTES		PUMPING WATER WELL LEVEL	DRAWDOWN	OBSERVATION WATER WELL LEVEL	DRAWDOWN
11/30/79						
9:20 AM	0		4,473.00		4,473.00	
9:30 AM	begin pumping					
9:40 AM	10		4,442.85	-30.15		
9:43 AM	13				4,472.35	-0.65
9:50 AM	20		4,442.35	-30.65		
9:55 AM	25				4,472.10	-0.90
10:00 AM	30		4,442.25	-30.75		
10:10 AM	40		4,442.15	-30.85		
10:15 AM	45				4,471.50	-1.50
10:20 AM	50		4,442.15	-30.85		
10:35 AM	65				4,471.20	-1.80
11:00 AM	90		4,442.15	-30.85		
11:55 AM	145				4,470.60	-2.40
Noon	150		4,442.15	-30.85		
12:55 PM	205				4,470.45	-2.55
1:00 PM	210		4,442.15	-30.85		
1:55 PM	265				4,470.25	-2.75
2:00 PM	270		4,442.15	-30.85		
2:55 PM	325				4,470.05	-2.95
3:00 PM	330		4,442.15	-30.85		
3:55 PM	385				4,470.00	-3.00
4:00 PM	390		4,442.15	-30.85		
4:55 PM	445				4,469.95	-3.05
5:00 PM	450		4,442.15	-30.85		
5:55 PM	505				4,469.95	-3.05
6:00 PM	510		4,442.15	-30.85		
8:00 PM	630		4,442.15	-30.85		
8:05 PM	635				4,469.95	-3.05
11:00 PM	810		4,442.15	-30.85		
11:05 PM	815				4,469.95	-3.05
12/01/79						
12:30 AM	900		4,442.15	-30.85		
12:30 AM	pump off--start recovery test					
	0					
	(t')	(t)		(s')		
12:33 AM	3	903	4,452.45	-20.55		
12:35 AM	5	905	4,455.85	-17.15		
12:37 AM	7	907	4,458.05	-14.95		
12:39 AM	9	909	4,459.75	-13.25		
12:41 AM	11	911	4,461.05	-11.95		
12:45 AM	15	915	4,463.15	- 9.85		
12:50 AM	20	920	4,464.95	- 8.05		
1:00 AM	30	930	4,467.65	- 5.35		
7:40 AM	430	1330	4,472.60	- 0.40		

Test well located in the SE¼ of the SE¼ of Section 29, T21N, Range 20E, MDB&M, Washoe County, NV

TIME DRAWDOWN CHART

4473' WATER SURFACE BEFORE PUMPING BEGAN

OBSERVATION WELL 308' EAST

PUMPING WELL Q=1200 gpm

1 HR. 2 HRS. 3 HRS. 4 HRS. 5 HRS. 6 HRS. 7 HRS. 8 HRS. 9 10 11 12 13 14 15

4485' 4480' 4475' 4470' 4465' 4460' 4455' 4450' 4445'

PUMPING LEVEL in feet

PUMPING LEVEL in feet Scale 1"= 5'

ELAPSED TIME SINCE PUMPING STARTED in hours Scale 1"= 1hr

waterresource consulting engineers

PLATE V

TIME - DRAWDOWN CHART

WWDD342120

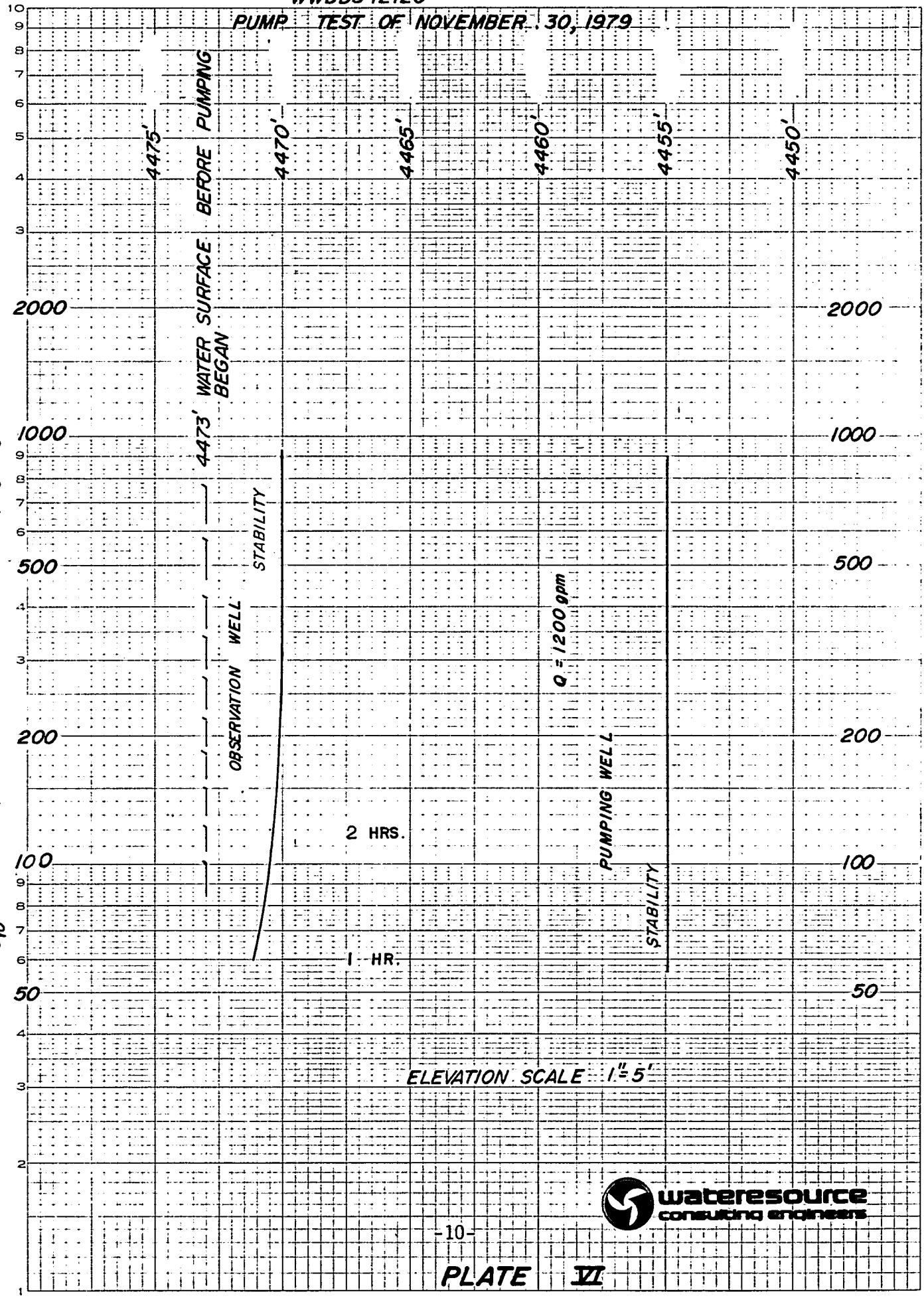


PLATE VI

waterresource consulting engineers

TIME–RECOVERY CHART

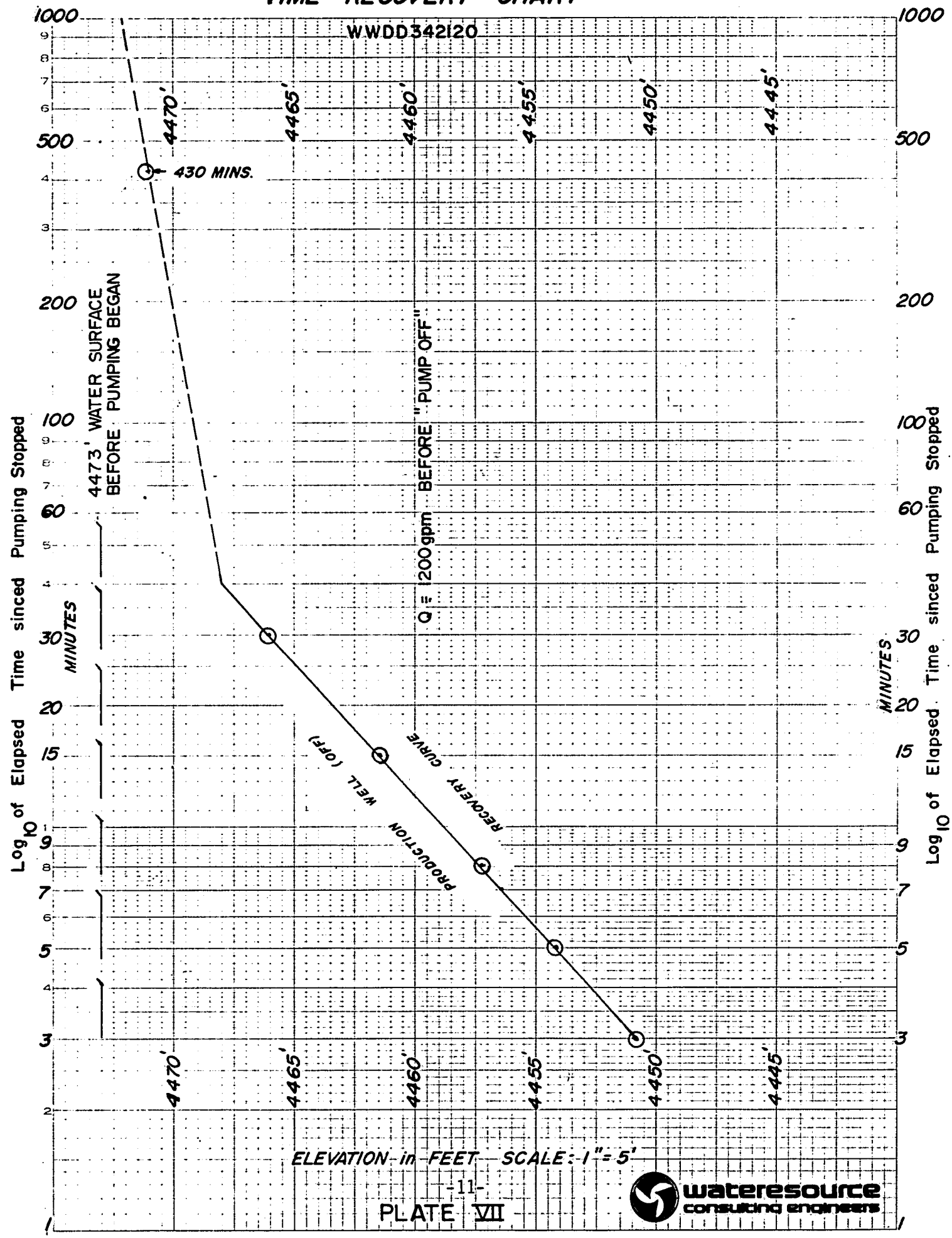


PLATE VII

waterresource consulting engineers

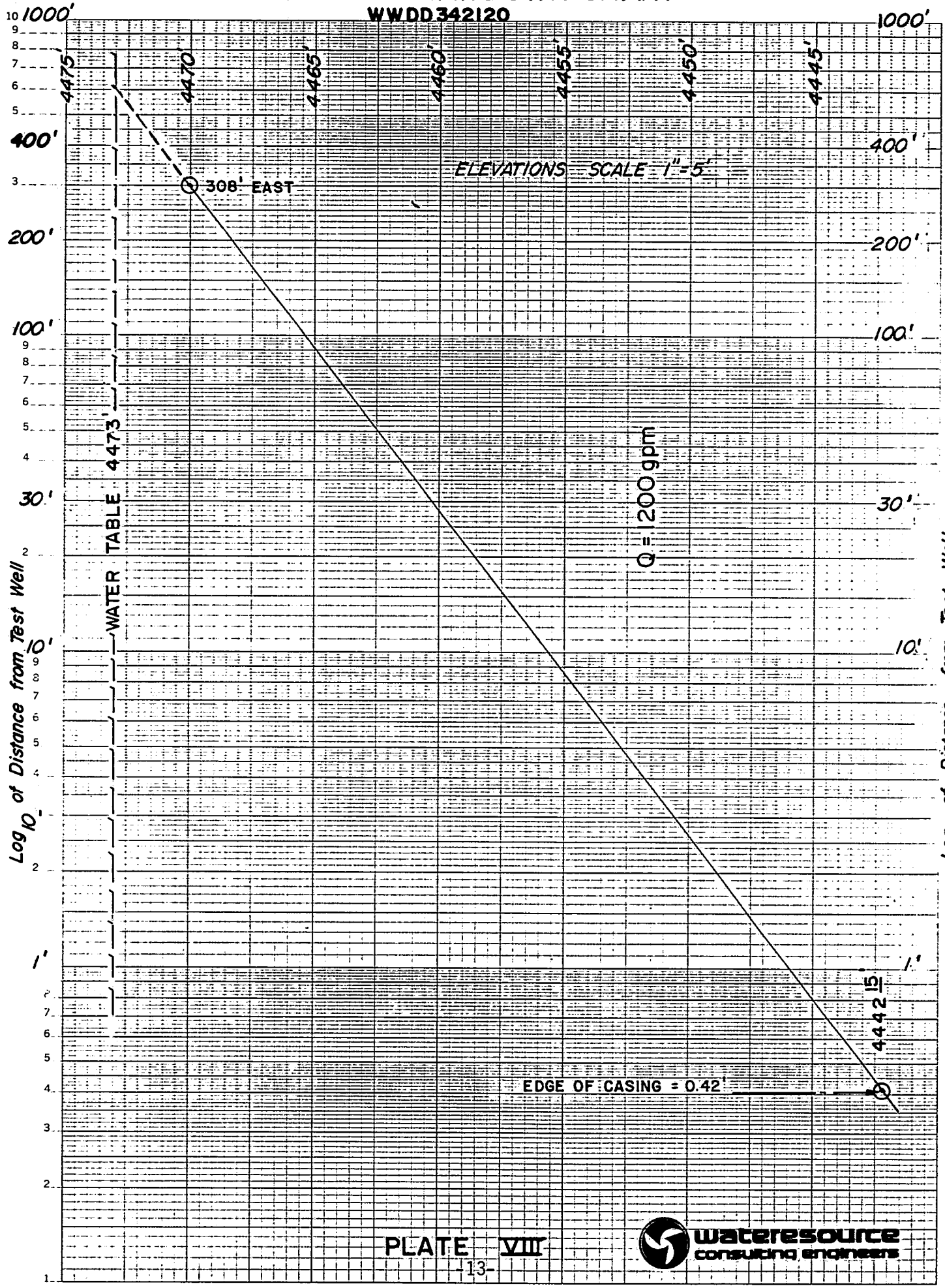
6. DATA ANALYSIS

The location of this replacement well did not offer an opportunity to develop an artesian aquifer. The water table aquifer was developed here but no amount of pumping and testing will demonstrate the ideal way in which natural recharge is capable of furnishing water to the drawpoint. Pumping a water table aquifer actually dewaters a "cone of depression" around the well. Whenever pumping is continuous through several days or weeks, that cone expands to include an area which is adequate to furnish the water being pumped. The water table aquifer which is developed by the subject well is capable of transmitting water readily which permits the pumping level to stabilize quickly at the established 1,200 gpm pumping rate. All this results in a very modest lowering of the water table outside of a 600- or 700-foot radius from the pumping well (see Distance-Drawdown chart, Plate VIII, page 13).

Plate IX (envelope at back of Report) is a drawing which was prepared to illustrate the movement of underground water whenever a water table aquifer is being pumped. The events may be described in some rational sequence as follows:

The pump is activated and as water is forced from the well, the dynamic pumping level is lowered. This lowering of water represents a decrease in pressure head on the aquifer. It may be observed in the subject well that whenever the pumping rate "Q" is 1,200 gpm, the dynamic pumping level stabilizes 30.85 feet below the water table. This, in turn, represents a pressure reduction on the aquifer of 30.85 x 0.4335 = 13.4 pounds per square inch (psi) at the dynamic pumping level. This reduction in pressure at the casing wall is in balance with the pumping rate of 1,200 gpm for the pumping well. Pumping is continued at a constant rate and the area involved in furnishing the water being pumped continues to grow by way of an increasing radius. This area, which is commonly

DISTANCE – DRAWDOWN CHART



46 6010

K+E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO.

PLATE VIII

waterresource consulting engineers

called a cone of depression, takes the form of parabolic curve which is rotated through 360 degrees. The radius will increase until the area involved is equal to that required by recharge to furnish the water being pumped.

Recharge is available from both primary and secondary sources. Primary recharge is that water made available through rainfall and snowmelt. As stated on page 2, the average annual precipitation here is in the range of eight (8) inches, while a more conservative seven (7) inches is used for all computations herein. The Groundwater Division of the U.S.G.S. estimates that roughly two percent of all precipitation in this area is available to recharge the water-bearing aquifers whenever there is little or no water being withdrawn from the underground. It has been demonstrated in many water basins that pumping and use of water is required to induce natural or primary recharge. Whenever significant demands are made on the water-bearing formations here, it is altogether probable that 30 or 40 percent of all moisture falling on the watershed will become available to recharge the underground system. At the present time and under very low use conditions, 99 percent of the natural precipitation falling on this watershed is lost and not available for the beneficial use of man. This moisture is evaporated at or near the surface during storms or between storms; it is evapotranspired by plant life through their root and foliage systems, and it is lost underground to the lower Truckee Meadows and Truckee River system. Only through lowering the water table slightly through extractions and use of the underground waters will it be possible to induce primary recharge to inure to the benefit of man. Whenever this is done through extraction and use of the underground waters, then they will be able to capture and use, in a beneficial way, at least one-third of all those waters falling on the entire watershed. In this analysis, the more conservative amount of fifteen percent will be used in computations.

Consider now that seven (7) inches of annual precipitation is equal to 7/12 = 0.583 feet and fifteen percent of that is 0.0875 feet of potential annual recharge all over the watershed. It follows then that the watershed required to balance the 2,000 acre-feet of permitted water rights would be as follows:

$$\frac{2{,}000 \text{ A.F.}}{(0.0875) \times (640 \text{ acres/sq.mi.})} = 35.7 \text{ sq.mi.}$$

Consider now the very important secondary recharge which occurs whenever farm fields are irrigated or quasi-municipal use of water is made upon the land. Lands which are occupied by residential users of water which employ the septic-leach field system (ISDS) for wastewater disposal offer the greatest opportunities for secondary recharge. A conservative estimate is that a minimum of 75 percent of all waters used inside the residence and 30 percent of all waters used outside the residence will return to the underground system, and further assuming that 50 percent of irrigation season use and 100 percent of non-irrigation season use is inside, it follows that:

$\frac{(500 \times 0.75 \times 365) + (500 \times 0.30 \times 150)}{365}$ = 437 gallons/day average per unit is recharged to the aquifer. In turn, 437/705 = 62 percent of the total water used.

It naturally follows then that the watershed required to furnish the permitted rights will be reduced by 62 percent or more whenever the water is being beneficially used upon the land. Total use of the 2,000 A.F. would reduce the required watershed to 35.7 - (35.7 x 0.62) = 35.7 - 22.1 = 13.6 sq.mi. Referring to Plate I (envelope at back of report), it is obvious that the watershed available is in the range of three times the watershed required. Therefore, the pumping of 2,000 A.F. per year will not be adverse on the groundwater basin in this general area.

7. ARTESIAN AQUIFER COMPARISON

Test hole drilling and electric logging in this area has demonstrated that water wells can be constructed here which develop the artesian rather than the water table aquifer. Pumping water fron an artesian aquifer differs from pumping the water table aquifer in two important ways. First, there is no cone of depression or dewatered cone developed while pumping an artesian aquifer. Whenever the artesian aquifer is developed and pumped, there is a cone of influence or area of pressure release developed on the aquifer which has an area equal to that required for the clay-silt reservoir to yield the amount of water being pumped. In turn, the water level in the upper water table aquifer is lowered a small amount (a few inches) to establish a hydraulic gradient which stimulates the movement of water in the direction of the well. All that is required of the water table aquifer is to keep the clay-silt reservoir innundated. There is no noticeable lowering of the water table in any nearby water wells.

Secondly, there are no noticeable changes in the size or shape of the area of influence during wet or dry years. The area of water table aquifer required to receive recharge equal to production is in a continuous state of averaging throughout the climate cycle.

In the matter of pumping water from the artesian aquifer, much more time (in the range of 12 to 35 hours) is required to stabilize the pumping level. A much larger radius of influence is indicated at stability in an artesian aquifer than is shown on Plate VIII (page 13) for water table conditions. It is noted that had a series of observation wells located at distances greater than 308 feet from the production well been available, they would have illustrated

a cone of depression in the water table aquifer in excess of the 600-foot radius indicated on Plate VIII (page 13), although drawdown of the water surface beyong the 600-foot radius would be very slight, indeed.

8. SUMMARY

Desert Springs Utility Company (DAVCO) has permitted rights to develop and use up to 2,000 acre-feet per year of underground water in the northwest sector of Spanish Springs Valley. Based on an average unit-day use of 705 gallons, this amount of water will sustain the needs of approximately 2,530 residential units.

Test drilling, electric logging, and water well development upon the subject lands has proven beyond reasonable doubt that the permitted water rights can be developed in either the artesian or the water table aquifers. One recently completed test well which develops the water table aquifer is located in the SE¼ of Section 34 of Township 21 North, Range 20 East, MDB&M. This well was pumped at the rate of 1,200 gallons per minute over a period of 15 hours, wherein the pumping level was stable after only 30 minutes of pumping with a demonstrated specific capacity of 39 gallons per minute per foot of drawdown.

Geologically and hydrologically, the aquifers, the watershed, and the average annual precipitation will support the water uses which are intended. The primary recharge provided by natural rainfall and snowmelt is abundantly supplemented by secondary recharge which occurs in the forms of lawn watering and ordinary household uses of domestic waters.

Development of the artesian aquifers has less long-range impact on an underground water supply than does development of the water table aquifer; however, in this particular instance where the subject water well is more than 2,000 feet from any other production well, the effects of pumping will go unnoticed in this area.

No more water will be pumped from underground than is needed by occupants of the land; therefore, as more water is required, more secondary recharge becomes available. Secondary recharge within this development and at this location will be in the range of 62 percent of the total water used.

9. ENGINEERING CONCLUSION

From the preceding, it can be concluded that there is primary recharge available to the proposed development area in question to allow development of the permitted 2,000 AFY underground water rights. When coupled with the secondary recharge available from the development itself, there no longer remains a question as to whether sufficient recharge would be available to this area to support the development of 2,000 A.F. per year.

It is WCE/Meador's opinion that this is an ideal way to develop these types of areas for the proposed use, particularly when there is sufficient primary recharge with a significant back-up of secondary recharge. This system provides for an efficient total water resource utilization plan.

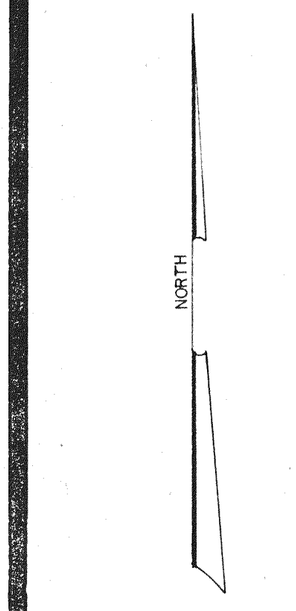
In summary, we believe it is evident from the data, calculations, and discussion presented herein that significantly more groundwater is available for development in this area, without adversely impacting the groundwater basin

or adjacent water rights, than the approximately 300 existing approved units in the Desert Springs Development and the proposed approximately 450 units under land use District Case No. C-93-79W will require.

We would be remiss in not noting that we, as engineers, strongly recommend that future wells developed for this project be constructed in the artesian aquifer to reduce the impact on the water table aquifer during drought periods. As discussed in the report, the artesian aquifer is more capable of withstanding drought periods due to the storage capability of the confining clay-silt beds.

* * * * *

VICINITY MAP



SUTCLIFFE 18 MILES

R 20 E
R 21 E

WATERSHED BOUNDARY

LANDS ASSOCIATED WITH 2000 AFY WATER RIGHTS

WELL NO.18 REPLACEMENT
TEST WELL

EFFECTIVE BOUNDARY

T 21 N
T 20 N

SPRINGS VALLEY

SPANISH

OHR DITCH

NEV. 33

WATERSHED BOUNDARY

TO CALIF.

US 395

PYRAMID WAY

SPARKS

RENO

SOUTHERN PACIFIC RAILROAD

US HIGHWAY 40

TRUCKEE RIVER

TO WINNEMUCCA

EFFECTIVE BOUNDARY AREA 44.50 SQ.MILES

TOTAL WATERSHED AREA 73.39 SQ.MILES

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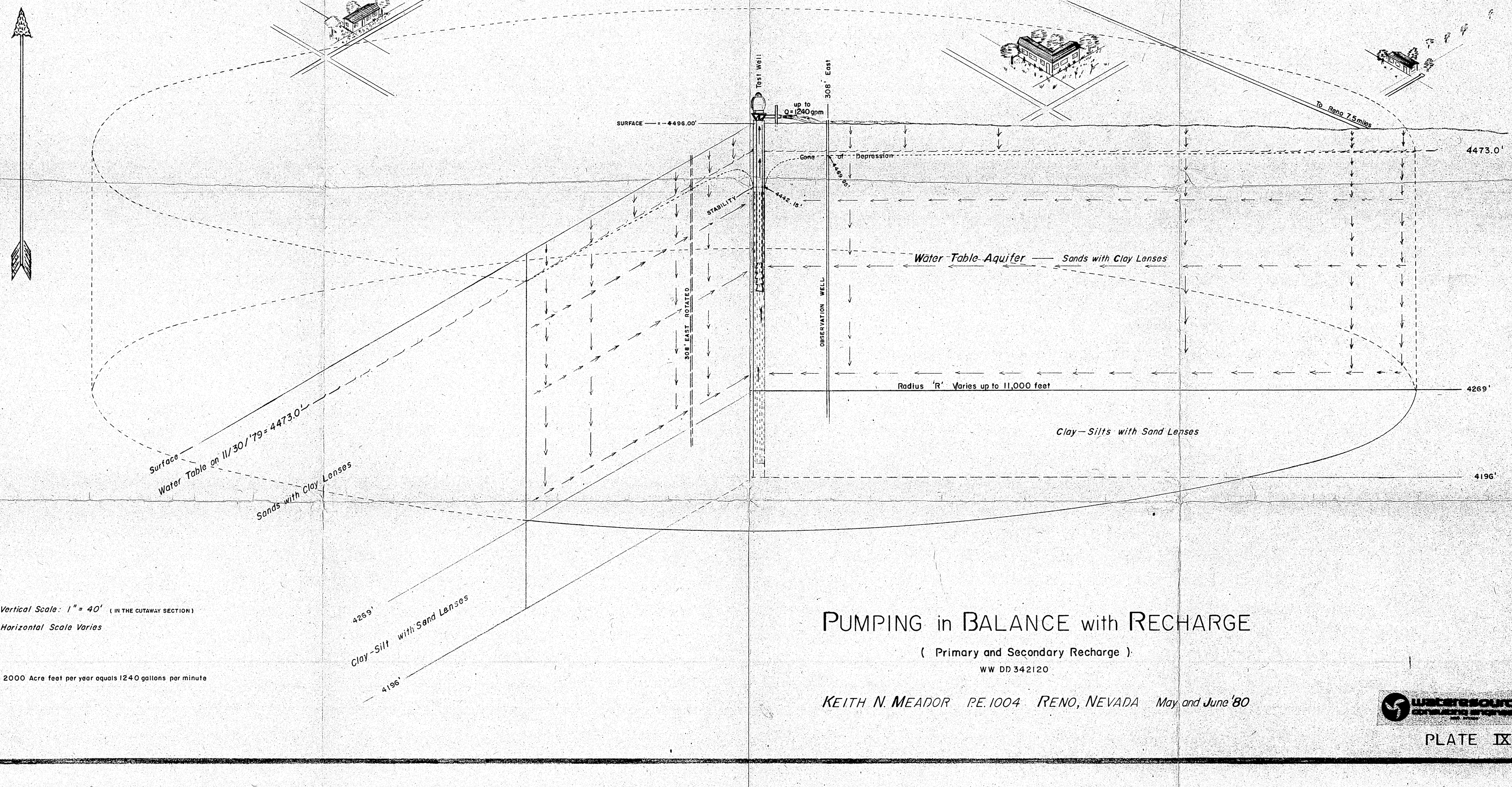
PLATE I



Vertical Scale: 1" = 40' (IN THE CUTAWAY SECTION)

Horizontal Scale Varies

2000 Acre feet per year equals 1240 gallons per minute

PUMPING in BALANCE with RECHARGE

(Primary and Secondary Recharge)

WW DD 342120

KEITH N. MEADOR P.E. 1004 RENO, NEVADA May and June '80

WATER RESOURCE ENGINEERS, INC.

PLATE IX